Gridless Narrow-Angle Astrometry with SIM

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Abstract

A new technique, Gridless Narrow-Angle Astrometry (GNAA), is proposed for the Space Interferometry Mission (SIM) to reach an accuracy of 1 μas in the early stages of the mission. The technique is useful for measuring periodic signals with P << 1 yr. GNAA not only enables the early exciting scientific results, but also provides useful tool to improve instrument performance.

The 'standard' narrow angle astrometry approach planned for SIM relies on accurate knowledge of grid stars. The narrow angle measurement process can not achieve its full accuracy before the end of the five year mission because grid star positions, proper motions and parallax are not known to their potential accuracy. So several grid campaigns (each about three weeks) per year are critical for the accuracy of narrow angle astrometry.

In GNAA, the grid stars are not used. Instead, a set of reference stars and a target star is observed at several baseline orientations. Without solving for baseline length, precise baseline orientations, etc., the target star positions are determined relative to a common reference frame by iteration. As with narrow angle astrometry, an affine transformation absorbs SIM instrument parameters. Simulations indicate that GNAA can measure changes in the position of the target relative to the reference frame at the μas level. Even for extended period in which the reference frame deforms by ten *mas*, the noise level remains $\approx$ 1μas. The technique, the preliminary simulation results, the efficiency, and the parametric sensitivities will be discussed here.

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